

Multicriteria Decision Tools for Sustainable Developments of Management Strategies for Environmental Issues

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Goal and Scope . The 'sustainable development' due to political decision is now a wording, which can be heard everywhere. There are typical components directly related to sustainable developments: They project into the future; there are sociological, economical and ecological criteria; and there are options, which are to be classified depending on their fulfillment of those criteria. Within a multidisciplinary project, funded by the German Federal Foundation of Environment, methods are to be developed to evaluate the degree of sustainability for water management strategies in the area of Berlin. In this paper we present the application and comparison of different multicriteria evaluation and decision tools.

Methods . The project team defined different scenarios, derived a set of indicators such that the management strategies are characterized by vectors and analyzed the (huge) evaluation matrix with the help of several methods. We differentiate between an evaluation step and a following decision step. At the evaluation level, the assessment of weights, for example in order to define and find utility functions or to distribute preferences for certain indicators, is crucial with respect to sustainability, because weights reflect actual knowledge and actual preferences. Therefore, here we use the partial order ranking, Hasse diagram technique (HDT), as the main method. The main advantage of HDT is, that the problem of weights is consequently avoided. However at the decision level weighting and the distribution of preferences is appropriate because the participation of representatives might be necessary. Therefore other multicriteria decision methods were applied too. It is shown the role of partial order together with Formal Concept Analysis (FCA), with the Analytic Hierarchy Process (AHP), concordance analysis (ELECTRE) and another ranking method (PROMETHEE).

Results and Conclusions . A first result of the partial ordering process of the evaluation matrix is that many management strategies are incomparable and a decision with respect to one optimum strategy is not feasible. This seems to be a drawback at first, however it can be shown this is due to the antagonism between several indicators caused by different effects of the strategies on the area considered. For example, where a strategy A leads to lower phosphorus content in one of the numerous surface waters compared to a strategy B, the same strategy causes an increasing variation of the river discharge compared to strategy B. However in all other indicators A is "better" than B. Then it can be asked if strategy A has to be modified such that it is "better" in all indicators than B by, e.g., additional restoration measurements at this river section. Additional information is derived by applying the method of FCA. In the next step weights and preferences in the decision process are determined. Different decision scenarios are modeled applying simple versions of AHP, ELECTRE and PROMETHEE. Again partial ordering is used to analyze and visualize the effects of weighting and methods. It is shown that without the first evaluation/decision step, i.e., partial ordering, the ranking of strategies by methods using weights is not as transparent as needed for decisions in sustainable developments.

Recommendations and Outlook. The HDT is a powerful tool for analyzing and visualizing different effects of strategies. As the next step the combination of sophisticated methods of multivariate statistics together with HDT will be performed. As a possible final step it is aimed to establish a fuzzy partial ordering approach where the ranking between two strategies can be evaluated and a linear mapping using preferences by lobbies is practicable.